Homework

A steam power plant operates on a reheat–regenerative Rankine cycle with one reheater and two feedwater heaters, one open and one closed. Steam enters the high-pressure turbine at 15 MPa and 600 °C and the low-pressure turbine at 1 MPa and 500 °C. The condenser pressure is 5 kPa. Steam is extracted from the turbine at 0.6 MPa for the closed feedwater heater and at 0.2 MPa for the open feedwater heater. In the closed feedwater heater, the feedwater is heated to the condensation temperature of the extracted steam. The extracted steam leaves the closed feedwater heater as a saturated liquid, which is subsequently throttled to the open feedwater heater. By assuming that pumps are ideal and turbines have isentropic efficiency of 85%, Determine

(*a*) the fraction of steam extracted from the turbine for the open feedwater heater (*z*)

(*b*) the thermal efficiency of the cycle, η_I

(*c*) the net power output for a mass flow rate of 42 kg/s through the boiler

(*e*) the exergy analysis of each component and the whole cycle and the second law efficiency of the cycle, η_{II}